

**What is claimed is:**

1. A vibrator comprising:  
a piezoelectric sheet;

5 internal electrodes formed on the upper and lower portions of said piezoelectric sheet;

cover layers, wherein at least one of the cover layers is formed on each of the upper and lower portions of said piezoelectric sheet on which said internal electrodes are formed; and

10 external electrodes, each of which is connected to each of the internal electrodes;

wherein said cover layer is provided with a vibration groove, said piezoelectric sheet is fabricated by forming a sheet of slurry, and the vibrator is fabricated by simultaneously sintering said piezoelectric sheet and said cover layers.

2. The vibrator according to claim 1, wherein said cover layer comprises a first cover layer where a through-hole is formed and a second cover layer, which covers the through-hole.

3. A vibrator comprising:  
a piezoelectric sheet;

20 internal electrodes formed on the upper and lower portions of said piezoelectric sheet;

cover layers, wherein at least one of the cover layers is formed on each of the upper and lower portions of said piezoelectric sheet on which said internal electrodes are formed; and

external electrodes, each of which is connected to each of the internal electrodes;

25 wherein vibration grooves are provided between said piezoelectric sheet and the cover layers, said piezoelectric sheet is fabricated by forming a sheet of slurry, and the vibrator is fabricated by simultaneously sintering said piezoelectric sheet and said cover layers.

4. The vibrator according to any one of claims 1 to 3, further comprising first and second surface external electrodes, which are formed on a surface of said cover layer, and each of which is connected to each of the external electrodes, and a third surface external

electrode, which is formed in the middle of the surface of said cover layer, and which is not connected to the external electrodes, wherein the extreme outer cover layers of the vibrator are dielectrics.

5        5.        The vibrator according to any one of claims 1 to 3, further comprising at least one dielectric sheet, in which internal electrodes are formed, wherein said dielectric sheet is laminated and combined on the upper portion and/or the lower portion of the vibrator.

6.        The vibrator according to claim 5, wherein the vibrator is three-terminal type, that is, said external electrodes are connected to the internal electrodes of a piezoelectric portion and a capacitor portion in both ends and in the middle of the vibrator, respectively.

10       7.        A method for fabricating a vibrator comprising steps of:  
             fabricating plural piezoelectric green sheets of slurry having desired composition;  
             forming first upper and lower cover layers by forming through-holes in  
             predetermined sheets of the green sheets;

15       providing predetermined sheets of the green sheets as a vibration active sheet and  
             second upper and lower cover layers;

             forming an upper internal electrode between the vibration active sheet and the first  
             upper cover layer and a lower internal electrode between the vibration active sheet and the  
             first lower cover layer;

20       laminating said first upper and lower cover layers on the upper and lower portions of  
             the vibration active sheet, respectively, and laminating said second upper and lower cover  
             layers on the upper and lower portions of the first upper and lower cover layers, respectively;  
             simultaneously sintering the laminate; and

             forming external electrodes, each of which is connected to each of the internal  
             electrodes, on said laminate.

25       8.        The method for fabricating a vibrator according to claim 7, wherein said step of  
             forming the first upper and lower cover layers comprises a step of filling at least one  
             through-hole of the first upper and lower cover layers with organic paste, and said step of  
             simultaneously sintering the laminate comprises a step of removing the organic matter by  
             heat treatment.

30       9.        The method for fabricating a vibrator according to claim 7, wherein said step of  
             forming the internal electrodes comprises a step of printing the upper and lower internal

electrodes on the upper and lower surfaces of the vibration active sheet.

10. The method for fabricating a vibrator according to claim 8, wherein said step of forming the lower internal electrode comprises a step of printing the lower internal electrode on the first lower cover layer which is filled with the organic paste.

5 11. A method for fabricating a vibrator comprising steps of:

fabricating plural piezoelectric green sheets of slurry having desired composition;

forming a lower cover layer by printing a vibration groove organic pattern on a predetermined sheet of the green sheets with organic paste and forming a lower internal electrode thereon;

10 forming a vibration active sheet by forming an upper internal electrode on a predetermined sheet of the green sheets and forming a vibration groove organic pattern thereon;

providing a predetermined sheet of the green sheets as an upper cover layer;

15 laminating said lower cover layer, said vibration active sheet, and said upper cover layer in the order thereof;

forming the vibration grooves by heat treating the laminate to remove the organic matter and simultaneously sintering the laminate; and

forming external electrodes, each of which is connected to each of the internal electrodes, on said laminate.

20 12. The method for fabricating a vibrator according to claim 8 or 11, wherein said cover layers comprise through-holes for burning passages through which the organic matter is communicated with an environment.

25 13. The method for fabricating a vibrator according to any one of claims 7 to 11, wherein said internal electrodes and external electrodes are formed by using thick film deposition, such as screen printing, or thin film deposition, such as sputtering, evaporation, chemical vapor deposition, or sol-gel coating.

14. A vibrator, wherein internal electrodes are not connected to external electrodes of the vibrator by controlling the pattern of internal electrodes in the vibrator.

15. A vibrator comprising:

30 a laminated element of at least two piezoelectric sheets;

internal electrodes formed between the laminated piezoelectric sheets; and

external electrodes formed outside the laminated element;

wherein the internal electrodes are not connected to the external electrodes by controlling patterns of the internal electrodes.

16. The vibrator according to claim 15, wherein each of the external electrodes is formed on each of the upper, lower and side portions of the laminated element.

17. The vibrator according to claim 15, further comprising insulators on the upper and lower portions of the laminated element, wherein a vibration groove is formed on the insulator.

18. The vibrator according to claim 15, further comprising conductive passages, which pass through the laminated element and are not connected to the internal electrode, and each of which is connected to each of the external electrodes.

19. The vibrator according to claim 17, further comprising three-terminal electrodes provided on a surface of the insulator on which the vibration groove is formed, wherein the insulators comprising dielectrics function as capacitors.

20. The vibrator according to claim 15, comprising at least one dielectric bonded to the laminated piezoelectric element.

21. The vibrator according to claim 20, wherein the dielectric is a laminated or single plate type.

22. The vibrator according to claim 15, wherein a dielectric substrate, which functions as a capacitor with terminals, is installed on the lower portion of the laminated element, and a protective cap for protecting elements is installed on the upper portion of the laminated element.

23. The vibrator according to claim 15, 16, 18, 20, or 21, wherein an insulating substrate where the external terminals are formed is installed on the lower portion of the laminated element, and a protective cap for protecting elements is installed on the upper portion of the laminated element.

24. The vibrator according to claim 17 or 19, wherein the laminated element and the insulators are green with epoxy for protecting elements.

25. A method for fabricating a vibrator comprising steps of:

fabricating piezoelectric green sheets of slurry having desired composition;

forming internal electrodes, which are not connected to external electrodes, on the

green sheets;

laminating at least two of the sheets on which the internal electrodes are formed;

sintering the laminate; and

forming external electrodes, which are not connected to the internal electrodes,

5 outside the laminate.

26. A method for fabricating a vibrator comprising steps of:

fabricating piezoelectric green sheets of slurry having desired composition;

forming through-holes at both ends of the green sheets;

10 forming internal electrodes on the green sheets so that the internal electrodes do not come into contact with the through-holes and are not connected to the external electrodes while said through-holes are filled with conductive paste;

laminating at least two of said sheets;

sintering the laminate; and

forming external electrodes, which are not connected to the internal electrodes and

15 are connected to the conductive paste of the through-holes, outside the laminate.

27. The method for fabricating a vibrator according to claim 25 or 26, wherein said internal electrodes are formed on a partial or near complete surface of the sheets so that the internal electrodes are spaced from the edges of the sheets.

28. The method for fabricating a vibrator according to claim 25 or 26, wherein said  
20 internal electrodes and external electrodes are formed by using thick film deposition, such as screen printing, or thin film deposition, such as sputtering, evaporation, chemical vapor deposition, or sol-gel coating.